

City and County of Honolulu
Department of Planning and Permitting

Instructions for Filing a
FLOODWAY PERMIT

(Section 21A-1.7 of the Revised Ordinances of Honolulu)

Application Material: Submit **three (3) copies** of each of the following items

1. Completed DPP Site Development Division Master Application Form.
2. Drawings/Plans: All drawings and plans must be black line prints, drawn to scale, and prepared by a licensed architect or engineer.
 - a. Site Plan showing the following:
 - (1) Dimensions of all lot lines.
 - (2) Flood Hazard Area designations and boundaries in relation to the existing and proposed structure(s). Include the Base Flood Elevation (BFE).
 - (3) Existing and proposed structures and improvements.
 - (4) Fill areas.
 - (5) Storage areas.
 - (6) Location and elevations of existing and proposed streets and utilities.
 - b. Building floor plans, elevation, and section drawings showing the following:
 - (1) The BFE, existing and proposed elevations including finish floor elevations, finish grades, highest adjacent grade (HAG), and lowest adjacent grades (LAG).
 - (2) Elevations based on local tidal datum elevation reference marks.
 - (3) Proposed flood-proofing measures, such as flood vents.
 - c. A topographic survey map stamped and signed by a licensed professional surveyor.

The drawings shall also be stamped and signed by the same licensed professional engineer who has performed and stamped the FEMA "No-Rise" Certification form and Flood Conveyance Calculations.

For document imaging purposes, submit one of the three sets of drawings at 11" x 17" format.

3. A written explanation on how the proposal will address all concerns as listed in the Justification Statement, Items A through K. (See Attachment 1.)
4. A draft copy of an executed Declaration of Restrictive Covenant (see template - Attachment 2). The Declaration of Restrictive Covenants must be inserted in the deeds and other conveyance documents of the property and filed with the Bureau of Conveyances of the State of Hawaii.

5. The FEMA map information for the property. If the information is not identified on the FEMA map, a flood study and drainage report will be required in areas where a study and report have not been reviewed and accepted by the City.
6. Certification forms signed and stamped by a licensed professional engineer and/or architect unless otherwise noted (see Attachments 3 to 5):
 - a. Floodway Certification.
 - b. Flood Fringe Certification.
 - c. FEMA "No-Rise" Certification form and Flood Conveyance Calculations.

The calculations and "No-Rise" determination must be **performed by a licensed professional engineer** and include proposed mitigation measures. Calculations shall show that there is no increase in the base flood elevation and no loss of conveyance of floodwater due to encroachment in the floodway. Mitigating measures may be used to compensate for the loss of conveyance.

Note: The information indicated on the certification forms shall match the information shown on the plans, sections, and elevation drawings.

Fees: \$600.00, checks are made payable to the City and County of Honolulu.

Additional Notes:

1. AUTHORIZED AGENT is the person or who is processing the permit. Provide complete contact information. This is the person that the Department will contact for all additional information.
2. For clarification on any of the above, please call the Subdivision Branch at 768-8100.

Justification Statement for Construction in the Floodway Area

Explain how the proposal will address each of the following:

- A. The danger to life and property, including surrounding properties due to increased flood elevations or velocities that may be caused by the project. Be sure to describe the surrounding properties, existing structures, and uses.
- B. The danger that materials may be swept onto other lands or downstream to injure others.
- C. The proposed water supply and sanitation systems, and the ability of these systems to prevent disease, contamination, and unsanitary conditions.
- D. The susceptibility of the proposed structure and its contents to flood damage and the effect of such damage on the individual owners.
- E. The importance of the services provided by the proposed structure to the community.
- F. The availability of alternate locations not subject to flooding for the proposed use.
- G. The compatibility of the proposed use with existing development anticipated in the foreseeable future.
- H. The relationship of the proposed use to the floodplain management program for the area.
- I. The safety of access to the property in times of flood for ordinary and emergency vehicles.
- J. The expected elevations and velocity of the base flood expected at the site due to the project.
- K. That the project will not result in an increase to the base flood elevations, additional threat to surrounding properties and to public safety, extraordinary public expense or conflict with other laws or regulations.

Declaration of Restrictive Covenants for Structure(s) Within the Floodway Area

Complete the Declaration of Restrictive Covenants and submit it with your application. Please make sure to sign and notarize the document, and include the legal description of the property as Exhibit 'A'. **DO** **NOT** record the covenants until you are notified of its acceptance.

LAND COURT SYSTEM

Return by Mail ()

To:

Pick Up ()

REGULAR SYSTEM

DECLARATION OF RESTRICTIVE COVENANTS

(STRUCTURE WITHIN FLOODWAY AREA)

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, _____, hereinafter referred to as
“DECLARANTS,” are the owners of that certain real property more fully described in Exhibit
“A” attached hereto, and by reference made a part hereof;

WHEREAS, the said real property is located within a “Floodway Area” as said term is
defined in the Flood Hazard Areas Ordinance of the City and County of Honolulu and said
property is subject to “flooding” as said term is defined therein and is subject to flood damage.

WHEREAS, Declarants are filing an Application with the Director of Planning and
Permitting of the City and County of Honolulu for a Floodway Permit to construct a structure
within the Floodway Area and that this Floodway Permit may result in an increase in premium
rates for flood insurance and that such construction increases risks to life and property.

NOW, THEREFORE, in consideration of the issuance of the Floodway Permit pursuant to the application filed by Declarants with the Director of Planning and Permitting, said Declarants covenant and agree as follows:

1. That the said Declarants, future owners, lessees, or tenants shall not file any claim, action or lawsuit against the City and County of Honolulu for costs or damages arising from the issuance of a Floodway Permit and arising from any flooding of the aforesaid property described in Exhibit "A";
2. That Declarants, future owners, lessees or tenants shall defend, indemnify and save harmless the City and County of Honolulu from any and all liability, loss, damage, injury or death resulting from the granting of the application for the Floodway Permit and from the flooding of the aforesaid property;
3. That these covenants shall take effect upon the issuance of the aforesaid Floodway Permit by the Director of Planning and Permitting and that these covenants shall be deemed as covenants running with the land.

DATED: Honolulu, Hawaii,_____.

Declarants

STATE of HAWAII)
) ss
CITY AND COUNTY OF HONOLULU)

On this _____ day of _____, 20____, before me personally
appeared _____ known to me to be the _____ Declarant
hereunder, described in and who executed the foregoing instrument, and acknowledge that he
executed the same as his free act and deed and as the act and deed of Declarant.

Notary Public, State of Hawaii
Print Name:

My commission expires:

NOTARY CERTIFICATE (Hawaii Administrative Rules §5-11-8)

Date of Doc: _____ # Pages: _____

Name of Notary: _____ Notes: _____

Doc. Description: _____

Notary Signature

Date

First Circuit, State of Hawaii

(stamp or seal)

NOTARY CERTIFICATION

Certification Forms

Please ensure the information indicated on the certification forms accurately reflect the information shown on the plans, sections, and elevation drawings.

FLOODWAY CERTIFICATION

(Pursuant to Chapter 21A of the Revised Ordinances of Honolulu)

New Projects, Developments and Substantial Improvements

Owner's Name _____

Project Description: _____

Address: _____ City: _____

State: _____ Zip: _____ Tax Map Key: _____

Section I – Flood Insurance Rate Map Information

COMMUNITY NO.	PANEL NO.	SUFFIX	DATE OF FIRM	FIRM ZONE	BASE FLOOD ELEV.	COMMUNITY ESTIMATED BASE FLOOD ELEVATION ESTABLISHED FOR ZONE A IF AVAILABLE

Section II – Elevation Information

1. Elevation of Lowest Floor ft.
2. Base Flood Elevation ft.
3. Depth Number ft.
4. Elevation of Highest Adjacent Grade ft.
5. Elevation of Lowest Adjacent Grade ft.
6. Elevation to which Structures are Floodproofed ft.

Section III – Standard Certification Statement

The plans, specifications and methods of construction for the proposed project are in accordance with accepted standards of practice for meeting the provisions of the Flood Hazard Ordinance, and:

1. Comply with the standards and requirements of the Flood Hazard Area Regulations of the Revised Ordinances of Honolulu;
2. Conform to the flood elevations of the Federal Emergency Management Agency Flood Insurance Rate Maps (FIRM); and
3. Are adequate to resist the regulatory flood forces; do not increase flood elevations; and do not affect flooding on surrounding properties;
4. The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to or above the regulatory flood elevation; and
5. The pile or column foundation and structure attached thereto is anchored to resist floatation, collapse and lateral movement due to the effects of wind and water loads acting simultaneously on all building components.

Section IV – Certification

Project plans and specifications include:

1. The location of flood hazard boundaries;
2. Existing and proposed elevations of the property in relation to the elevation reference marks on the Federal Flood Maps;
3. The flood elevations, velocity and other data from the Federal Flood Maps and study;
4. Existing and proposed structures, utilities and improvements; and
5. Proposed flood proofing measures and improvements.

This certification is conditioned upon the actual construction of the project being in strict accordance with the plans and specifications as stamped and signed by me.

Affix Seal Below

Certifier's Name _____
(print or type)

Title _____

Company Name _____

Street Address _____

City _____ State _____ Zip _____

Engineer or
Architect

Signature _____ Date _____

FLOOD FRINGE CERTIFICATION

(Pursuant to Chapter 21A of the Revised Ordinances of Honolulu)

New Projects, Developments, and Substantial Improvements

Owner's Name: _____

Project Description: _____

Address: _____ City: _____

State: _____ Zip: _____ Tax Map Key: _____

Section I – Flood Insurance Rate Map Information

COMMUNITY NO.	PANEL NO.	SUFFIX	DATE OF FIRM	FIRM ZONE	BASE FLOOD ELEV.	COMMUNITY ESTIMATED BASE FLOOD ELEVATION ESTABLISHED FOR ZONE A IF AVAILABLE

Section II – Elevation Information

1. Elevation of Lowest Floor (must be at or above Base Flood Elevation) _____ ft.
2. Elevation of Highest Adjacent Grade next to Building _____ ft.
3. Elevation of Lowest Adjacent Grade next to Building _____ ft.
4. Elevation to which Structure is Floodproofed _____ ft.
5. For a Building with an Attached Garage:
 - a) Elevation of garage floor _____ ft.
 - b) Square footage of attached garage _____ ft.
 - c) Number of permanent flood openings in the attached garage within 1.0 foot above adjacent grade _____
 - d) Total net area of flood openings _____ sq.in.
 - e) Engineered flood openings? ☐ Yes ☐ No
6. For a Building with a Crawlspace or Enclosure:
 - a) Elevation of crawlspace or enclosure floor _____ ft.
 - b) Square footage of crawlspace or enclosure floor _____ ft.
 - c) Number of permanent flood openings in the crawlspace or enclosure floor within 1.0 foot above adjacent grade _____
 - d) Total net area of flood openings _____ sq.in.
 - e) Engineered flood openings? ☐ Yes ☐ No
7. Elevation of lowest machinery or equipment servicing the building (example: water heater, laundry facilities, AC units, PV/chargers) _____ ft.

Section III – Standard Certification Statement

The plans, specifications and methods of construction for the proposed project are in accordance with accepted standards of practice for meeting the provisions of the Flood Hazard Ordinance, and:

1. Comply with the standards and requirements of the Flood Hazard Area Regulations of the Revised Ordinances of Honolulu;
2. Conform to the flood elevations of the Federal Emergency Management Agency Flood Insurance Rate Maps (FIRM); and
3. Are adequate to resist the regulatory flood forces; do not adversely increase flood elevations; and do not adversely affect flooding on surrounding properties;

Section IV – AE, AH, AO, and A Zones Certification Statement

I certify that based upon development and/or review of structural design, specifications, and plans for construction that the design and methods of construction are in accordance with accepted standards of practice for meeting the following provisions:

1. Residential structures (a) in AE and AH Zones, have the lowest floor (including basement) elevated to or above the base flood level; and (b) in AO Zone have the lowest floor (including basement) elevated above the highest adjacent grade at least as high as the depth number specified in feet on the FIRM;
2. Non-residential structures (a) in AE and AH Zones, have the lowest floor (including basement) elevated to or above the base flood level; and in AO Zones have the lowest floor (including basement) elevated above the highest adjacent grade at least as high as the depth number; or, (b) together with attendant utility and sanitary facilities, is designed so that below the base flood level the structure is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy; and
3. Fully enclosed areas below the base flood level shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters.

Section V – Certification

Project plans and specifications include:

1. The location of flood hazard boundaries;
2. Existing and proposed elevations of the property in relation to the elevation reference marks on the Federal Flood Maps;
3. The flood elevations, velocity and other data from the Federal Flood Maps and study;
4. Existing and proposed structures, utilities and improvements; and
5. Proposed flood proofing measures and improvements.

This certification is conditioned upon the actual construction of the project being in strict accordance with the plans and specifications as stamped and signed by me.

Affix Seal Below

Certifier's Name _____
(print or type)

Title _____

Company Name _____

Street Address _____

City _____ State _____ Zip _____

Signature _____ Date _____

Engineer or
Architect



Federal Emergency Management Agency

Washington, D.C. 20472

CERTIFICATION OF A "NO-RISE" DETERMINATION

FOR A PROPOSED FLOODWAY DEVELOPMENT

Community Name

Development Name

Lot/Property Designation

Property Owner

I hereby certify that the proposed remedial measures, in combination with the property development designated above, will result in no loss of flow conveyance during the occurrence of the 1 percent annual chance of exceedence (100-year flood) discharge.

I further certify that the data submitted herewith in support of this request are accurate to the best of my knowledge, that the analyses have been performed correctly and in accordance with sound engineering practice, and that the proposed structural works are designed in accordance with sound engineering practice.

Date

Registered Professional Engineer

Seal



Federal Emergency Management Agency

Washington, D.C. 20472

CERTIFICATION REQUIREMENTS FOR SIMPLE FLOODWAY ENCROACHMENTS

Introduction

This document is intended to provide guidance to local floodplain administrators in evaluating requests for the placement of fill at a single location, a building, or another simple encroachment within an adopted regulatory floodway. The procedure contained in this document is not intended to evaluate complex encroachments, such as extensive fills, multiple structures, bridges, or levees, where flow expansion and contraction losses may be significant. In such cases, full hydraulic analyses by computer backwater models should be employed. The minimum floodplain management requirements for communities participating in the National Flood Insurance Program (NFIP) in which a regulatory floodway has been designated prohibit any floodway development that would result in an increase in flood levels within the community during the occurrence of the base (100-year) flood discharge. This requirement is outlined in Paragraph 60.3(d)(3) of the NFIP regulations.

Because floodway development is contradictory to the tenets of sound floodplain management, such development is discouraged by the Federal Emergency Management Agency (FEMA). Therefore, these certification requirements assume that all practical alternatives to floodway development have been investigated thoroughly and have been deemed not feasible.

In accordance with the NFIP regulations, it is ultimately the responsibility of each community participating in the NFIP to prohibit floodway development that would result in increases in 100-year flood levels. Communities must make determinations of this type and maintain backup calculations and certifications in their files for review by FEMA personnel upon request.

This document also does not address the many cases and situations requiring the actual revision of the floodway via redelineation of the floodway boundary, the criteria for which are presented in Section 65.7 of the NFIP regulations. A FEMA document, entitled "Conditions and Criteria for Floodway Revisions," and dated August 27, 1984, addresses these issues.

Definition of "No-Rise"

It is important that the concept of "no rise" be clarified and understood. The actual wording of Paragraph 60.3(d)(3) of the NFIP regulations is that the community shall "prohibit ... any increase in flood levels during the occurrence of the base flood discharge." If an adopted regulatory floodway has been computed and is displayed on the effective NFIP map, all areas within the floodway are considered to be effective in conveying the 100-year flood discharge. Therefore, no obstruction, regardless of size, can be

placed within the floodway without obstructing flow and causing some increase in the base flood elevation (BFE). Such increases may be localized and may seem insignificant; if modeled, they may yield changes on the order of hundredths or thousandths of a foot.

There has been a tendency to misinterpret the "no-rise" criterion to include rounding allowances and also to conclude that an increase in computed water-surface elevation of 0.01 foot or less, as determined by a backwater computer model, is sufficient evidence to support the acceptability of development in a floodway.

Although the backwater computer model output may show little change in water-surface elevation, closer examination will, in all likelihood, reveal changes in other variables (e.g., topwidth, flow area, velocity). These changes can be translated into increases in water-surface elevation that may not be considered significant by themselves. However, the long-term cumulative effects of such increases will eventually result in significant changes. Therefore, no development in the floodway should occur without proper compensation for the lost conveyance. This is the intent of Paragraph 60.3(d)(3) of the NFIP regulations.

It is FEMA's position that this regulation is to be interpreted exactly, and strictly, as written; that is, "no" rise above the BFE will be permitted. Therefore, nothing that offers any resistance to the flow of floodwaters may be placed within a regulatory floodway unless compensatory action is taken to restore the lost conveyance.

Loss of Conveyance

In the case of a simple floodway encroachment, as discussed previously, a "no-rise" determination can usually be made based on consideration of conveyance only. In such a situation, it is the difference in the conveyance before and after encroachment, or the aforementioned loss of conveyance, that must be addressed if the effects of development are to be compared against the "no-rise" criterion. The computation of loss of conveyance is most appropriately accomplished on a micro scale by isolating a portion of a cross section, separate from the backwater computer model, and performing hand computations. Examples of typical hand computations for proposed fill and bridge pier construction are attached for reference. However, it is appropriate to incorporate one or more new cross sections at the site of the proposed construction that reflect existing conditions into the unencroached and encroached backwater computer models. This is done to establish the base flood conditions at that location, which are to be used in the hand computations. The formula used to determine conveyance (K) is

$$K = 1.49/n AR^{2/3}$$

where n = Manning's roughness coefficient
 A = Flow area
 R = Hydraulic radius

The loss of conveyance is computed using the "n" value and hydraulic radius at the site of the encroachment as applied in the computer model.

Compensation

Once a determination has been made as to the amount of conveyance lost as a result of the proposed development, the designer or engineer is required to adequately compensate for this loss. This compensation is accomplished by including some means or measures within the proposed floodway development for providing an increase in effective conveyance, at some point on the cross section, equal to or greater than that lost. Equal area exchanges are only valid if the "n" value and hydraulic radius remain unchanged between the encroachment site and the compensation site. It is also important that the flow area provided be truly effective; that is, open to inflow and outflow and not just an isolated low spot or depression. This increased effective conveyance could be computed by hand in a manner similar to that used to compute the loss of conveyance.

The means or measures used to provide this effective conveyance (e.g., excavation, roughness coefficient reduction) would be at the discretion of the designer or engineer but must be approved by the community. Where these means and measures require some form of maintenance, the community must assume ultimate responsibility for their maintenance.

Data Requirements

The items identified below are necessary to document and demonstrate compliance with the "no-rise" criterion for simple floodway encroachments.

1. Hydraulic backwater models of the 100-year flood and floodway water-surface profiles for the following:
 - a. Duplicate of the effective Flood Insurance Study (FIS) model.
 - b. Existing-conditions (effective FIS) model modified to include cross sections through the project site. Cross sections must reflect conditions prior to construction of the project.
 - c. Post-project conditions model. This model must include cross sections through the project site reflecting floodplain conditions after construction of the project. The 100-year flood (without floodway) and floodway elevations for this model must not be greater than those in the existing-conditions model described at letter "b" above. This hydraulic backwater model is necessary to ensure that any changes in transition losses, which are based on velocity heads rather than conveyance, do not cause increases in water-surface elevations. Also, a hydraulic backwater model provides a means of evaluating effective flow areas upstream and downstream of the encroachment and compensation sites.
2. A copy of the appropriate NFIP map showing the existing floodway and indicating the project area
3. Topographic mapping of the entire project area indicating the locations of all cross sections used in the modified hydraulic model and a plan view of all project elements

4. Construction plans, certified by a registered professional engineer, for all project elements, including those measures employed to provide additional effective conveyance
5. The following information, to be obtained by hand computation using the cross section and 100-year encroached hydraulic data in the modified existing-conditions computer model output provided under Item 1b:
 - a. Calculation of the reduction in conveyance (K) caused by the proposed obstruction, assuming no change in floodway water-surface elevation, and using the "n" value appropriate for the site of the proposed obstruction
 - b. Calculation of the increase in conveyance (K) obtained by the proposed offsetting measure, using the "n" value appropriate for the site of this measure
 - c. Comparison showing that the conveyance increase computed in 5b equals or exceeds the loss computed in 5a
6. Evidence that the increase in effective conveyance provided for in Item 5b will be maintained perpetually. This should be in the form of a self-maintaining measure or certified maintenance plans for the measure provided.
7. An executed copy of the attached certification statement signed and sealed by a registered professional engineer

A copy of the hydraulic computer model for the effective FIS for the specified stream and community may be obtained by written request to the following address:

Federal Emergency Management Agency
Federal Insurance Administration
Risk Studies Division
500 C Street, SW
Washington, D.C. 20472

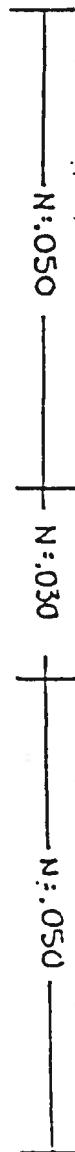
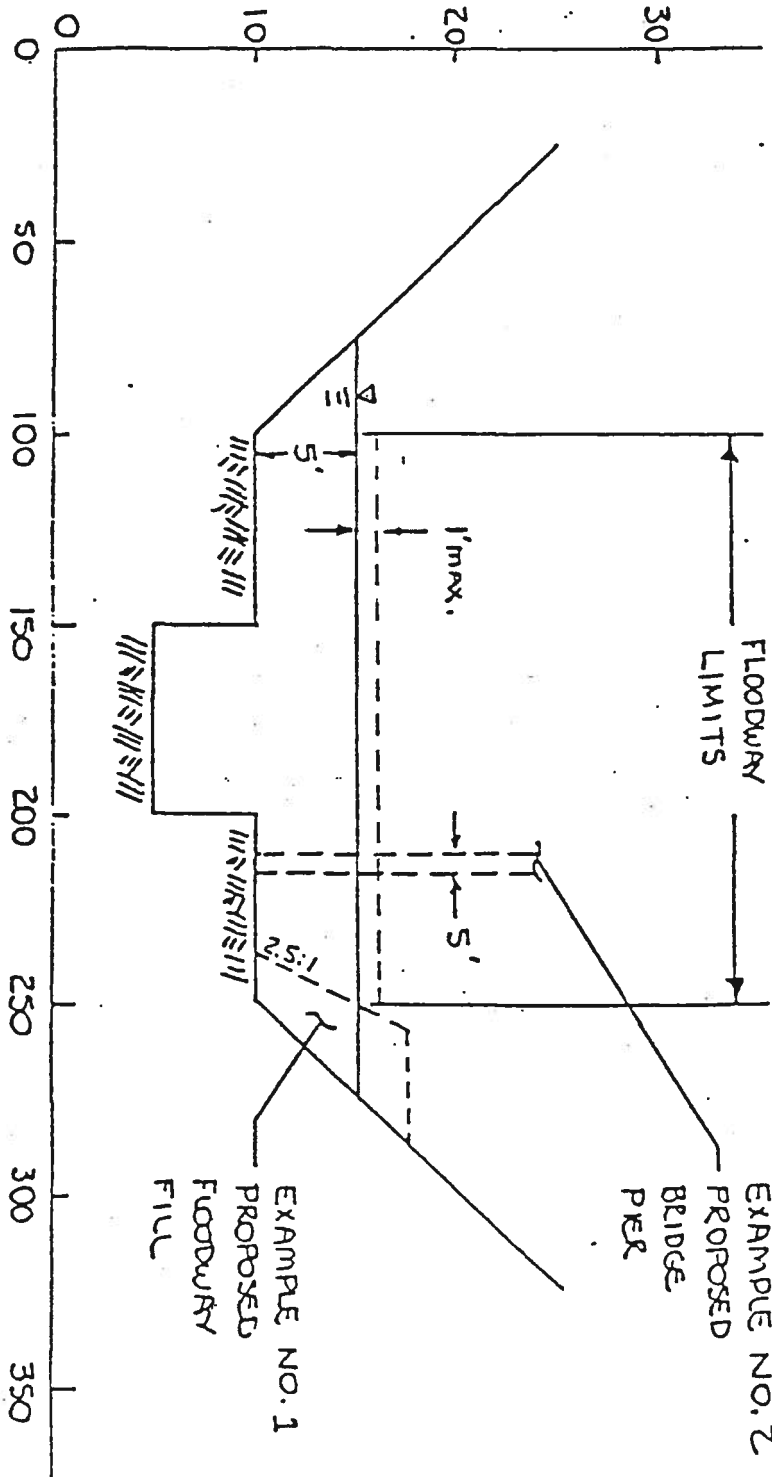
S.O. No. _____

Subject: CONVEYANCE CALCULATION

NO RISE FLOODWAY Sheet No. 1 of 6

TYPICAL SECTION Drawing No. _____

Computed by RCH Checked By JTP Date 5.14.90



S.O. No. _____

Subject CONVEYANCE CALCULATION

EXAMPLE NO. 1 Sheet No. 2 of 6

PROPOSED FLOODWAY FILL Drawing No. _____

Computed by RCH Checked By JTP Date 5-14-90

RIGHT OVBANK CONVEYANCE (PRE-DEVELOPMENT)

- ASSUMPTIONS:
1. PORTION OF FILL IN FLOODWAY FRINGE IS ALLOWABLE AND IS ACCOUNTED FOR IN FLOODWAY SURCHARGE
 2. PREDEVELOPMENT CONVEYANCE SHOULD ASSUME EXISTENCE OF WETTED PERIMETER ALONG FLOODWAY BOUNDARY
 3. MAXIMUM CONVEYANCE LOSS WILL OCCUR IN CONJUNCTION WITH FLOODWAY DEPTH THEREFORE USE FLOODWAY WATER SURFACE ELEVATION IN COMPUTATION
 4. CONVEYANCE LOSSES COMPUTED WITH FLOODWAY WATER SURFACE ELEVATION AND PROPERLY COMPENSATED FOR WILL NOT INCREASE 100-YEAR (BASE FLOOD) ELEVATION

THEREFORE:

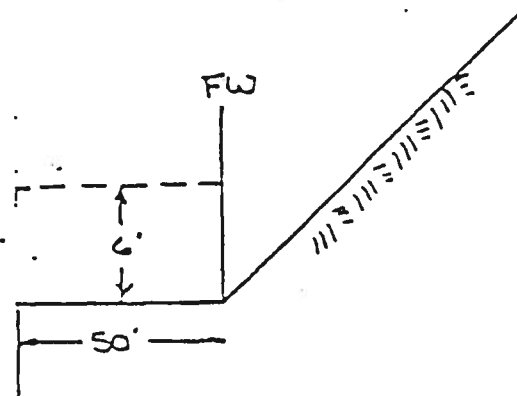
$$K_{PRE} = 1.49 / N A R^{2/3}$$

$$A = 50 \times 6 = 300 \text{ FT}^2$$

$$WP = 50 + 6 = 56 \text{ FT}$$

$$R = 300 / 56 = 5.36 \quad R^{2/3} = 3.06$$

$$K_{PRE} = 1.49 / .050 (300) (3.06) = \underline{27356.40 \text{ CFS}}$$



Subject CONVEYANCE CALCULATIONEXAMPLE NO. 1Sheet No. 3 of 6PROPOSED FLOODWAY FILL

Drawing No. _____

Computed by RCH Checked By JTPDate 5.14.90RIGHT OVBANK CONVEYANCE (POST-DEVELOPMENT)

ASSUMPTIONS: 1. ALL PREVIOUS

2. PROPOSED FILL SLOPES ABOVE FLOODWAY
WATER SURFACE ELEVATION AND OUTSIDE
FLOODWAY LIMIT DO NOT CONTRIBUTE
TO WETTED PERIMETER

THEREFORE:

$$K_{POST} = 1.49/N \cdot A R^{2/3}$$

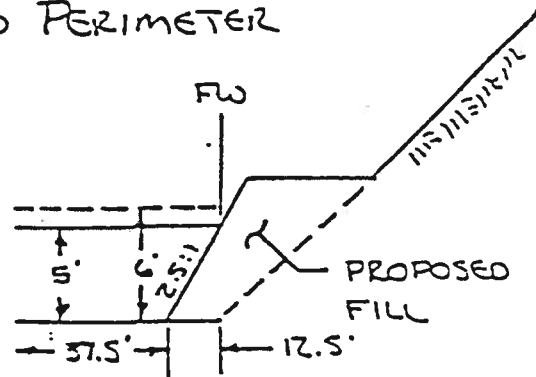
$$A = (1)(50) + \frac{1}{2}(5)(50+37.5)$$

$$= 268.75 \text{ FT}^2$$

$$WP = 37.5 + (12.5^2 + 5^2)^{1/2} + 0 = 50.96$$

$$R = 268.75 / 50.96 = 5.27 \quad R^{2/3} = 3.03$$

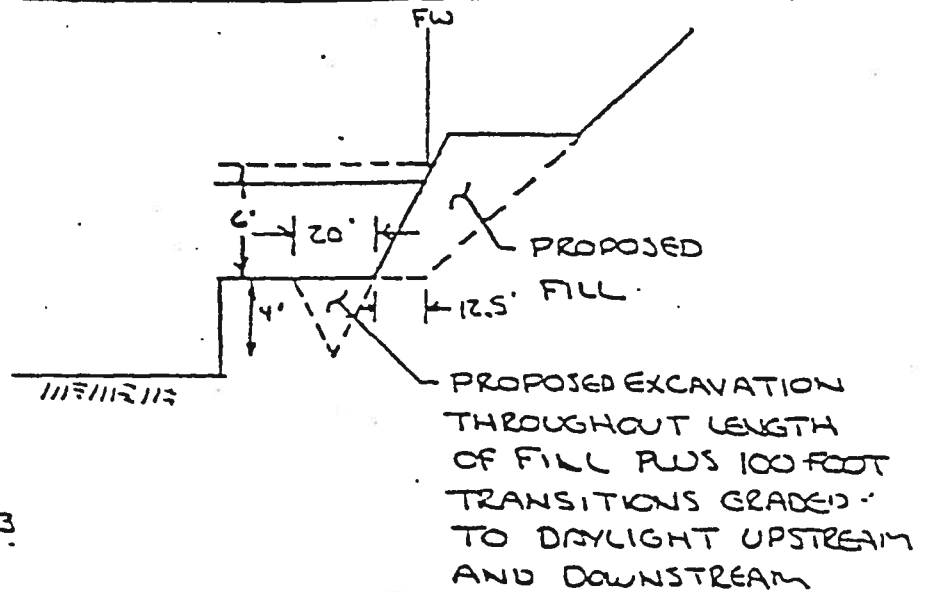
$$K_{POST} = 1.49 / .05 (268.75) (3.03) = \underline{24,266.51}$$

TOTAL CONVEYANCE LOSS IN FLOODWAY.

$$K_{PRE} - K_{POST} = 27,356.40 - 24,266.51 = \underline{\underline{3089.89 \text{ CFS}}}$$

Subject CONVEYANCE CALCULATIONEXAMPLE No. 1Sheet No. 4 of 6PROPOSED FLOODWAY FILL

Drawing No. _____

Computed by RCHChecked By JTPDate 5-14-90DESIGN OF CONVEYANCE COMPENSATION MEASURE

$$K_{PROP} = 1.49/N A R^{2/3}$$

$$A = 268.75 + \frac{1}{2}(20)(4)$$

$$= 308.75 \text{ FT}^2 > 300 \text{ FT}^2 \text{ (PRE)}$$

$$WP = 50.96 - 20 + (2)(10^2 + 4^2)^{1/2} = 30.96 + 21.54 = 52.50$$

$$R = 308.75 / 52.50 = 5.88 \quad R^{2/3} = 3.26$$

$$K_{PROP} = 1.49/.05 (308.75)(3.26) = 29994.45 \text{ CFS}_{PROP}$$

$$> 27356.40 \text{ CFS}_{PRE}$$

∴ OKAY

COMPENSATION

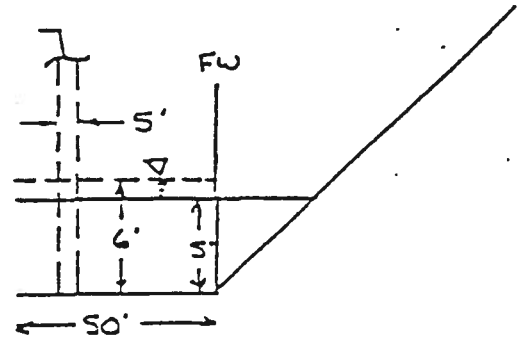
MEASURE

ADEQUATE

NOTE: FILL SLOPE WOULD REQUIRE ADEQUATE PROTECTION
AGAINST VELOCITIES AND CHECKS FOR STABILITY

Subject CONVEYANCE CALCULATIONEXAMPLE NO. 2Sheet No. 5 of 6PROPOSED BRIDGE PIER

Drawing No. _____

Computed by RCHChecked By JTPDate 5-14-90RIGHT OVBANK CONVEYANCE (PRE-DEVELOPMENT)SAME AS EXAMPLE NO. 1 = 27356.40 CFSRIGHT OVBANK CONVEYANCE (POST-DEVELOPMENT)PROPOSED
PIER
CONCRETE

$$A = (6)(50) - (6)(5) \\ = 300 - 30 = 270 \text{ FT}^2$$

$$WP = (50 - 5) + 2(6) + 6 \\ = 63 \text{ FT}$$

$$R = 270/63 = 4.29 \quad R^{2/3} = 2.64$$

WEIGHTED "N"

$$N_{\text{ROB}} = .050 \quad (50 - 5) + 6 = 51$$

$$51 + 12 = 63 = WP$$

$$N_{\text{CONC.}} = .013 \quad 2(6) = 12$$

$$N_w = \frac{51}{63} (.050) + \frac{12}{63} (.013) = .043$$

$$K_{\text{POST}} = 1.49 / .043 (270) (2.64) = \underline{24,699.35 \text{ CFS}}$$

TOTAL CONVEYANCE LOSS IN FLOODWAY

$$K_{\text{PRE}} - K_{\text{POST}} = 27356.40 - 24699.35 = 2657.05$$